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Measures to manage the rapid deterioration of the Arctic

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Introduction

The Arctic is gradually changing, at the end of this century the Arctic will not be the Arctic we know now, but it will (for example) have a completely different ecosystem. The Arctic has a major impact on global climate. It draws warm ocean water from the south, cools it, and sinks it toward the ocean bottom. Surface water moves in to replace the sinking water, this movement creates ocean currents and has a major influence on climate; it accounts for northern Europe's relatively mild climate compared with that of Canadian provinces at the same latitude, for example, and it keeps the tropics cooler than they would otherwise be. Meltwater from Arctic glaciers, ice caps, and the Greenland ice sheet also influences climate by flooding the ocean with freshwater, affecting ocean circulation and weather patterns. The Arctic is therefore both a source and sink for greenhouse gasses, which can have a long-term impact on global climate if the quantities change too drastically.

The Arctic is desired by many different countries for many different reasons. Countries like Singapore, China and the UK have an interest in Arctic routes and resources. Industries are drawn to the Arctic which unveils many tremendous economic opportunities, due to the melting ice.

The Arctic will never be what it was, but we can try to limit the consequences, especially on a short-term (50-100 years) base. This Research Report will outline the causes of deterioration, the consequences and the possible solutions, based on (scientific) reports.

Definition of Key Terms

The Arctic

The Arctic is a polar region located at the northernmost part of Earth. The Arctic consists of the Arctic Ocean, adjacent seas, and parts of Alaska (United States), Finland, Greenland (Denmark), Iceland, Northern Canada, Norway, Russia, and Sweden.[1]

Greenhouse gasses

One of several gases, especially carbon dioxide, that prevent heat from the earth escaping into space, causing the greenhouse effect.[2]

Sea-ice free

The Arctic Ocean is sea-ice free if the combined area of all fragments of ice is below 1 m per km^2.

Ice–albedo feedback

Since dark water absorbs more sun light than bright sea ice, any retreat of sea ice leads to additional heating of the Arctic Ocean, which in turn could lead to further and hence self-accelerating loss of sea ice.[3]

General Overview

Causes

There are many different causes for the deterioration of the Arctic. The melt is not just a seasonal process, it is being amplified by manmade global heating. Because of the melting ice, more of the dark ocean is exposed. The dark ocean absorbs more of the sun's heat then ice does and therefore ramps up the temperature even more (see Ice-albedo feedback). These changes are increasingly linked to more extreme weather, such as severe winters and deadly summer heatwaves at lower latitude such as in Europe and the United States of America.

Scientists have examined simulations of Arctic sea ice from the latest generation of global climate models. They found that the observed evolution of Arctic sea-ice area lies

[1] This definition is (mostly) copied from https://en.wikipedia.org/wiki/Arctic.
[2] Definition as stated by the Cambridge Dictionary.
[3] Definition as stated in 'Observations reveal external driver for Arctic sea-ice retreat', 2012.

within the spread of model simulations. In most simulations, the Arctic Ocean becomes sea-ice free in September for the first time before 2050.

Scientists have long suspected that the decline in summer sea ice was too strong to be caused by natural variations, such as weather patterns that cause fast changes in ice extent. Climate model simulations have shown that sea ice will decline as the Arctic gets warmer. But Arctic ice has declined faster than models predicted, raising the possibility that massive sea ice loss was caused at least in part by natural variations in weather.

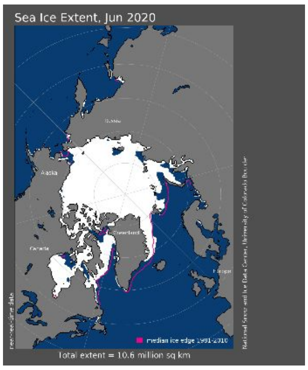
Dirk Notz observed that of all tested potential causes for Arctic sea-ice retreat only CO_2 actually remained on the list of possible drivers (this is supported by other studies), other research had previously shown a connection between sea-ice decline and global warming, however Notz's study showed a connection between sea-ice decline and human-caused climate change. The relationship between CO_2-concentration and sea-ice extent is as follows. The incoming long-wave radiation dominates the annual mean surface heat balance of sea ice in the Arctic. If this radiation is increased because of increasing CO_2-concentrations, a decreasing sea-ice extent would be a direct consequence. His study also shows that that the ice-albedo feedback, that could lead to self-acceleration of sea-ice retreat or advance, must currently be more than compensated for by negative feedbacks, preventing it from crossing the "tipping point". Some tested potential causes, that were later shown not to have a major impact on sea-ice retreat, are solar irradiance, cosmic rays, volcanic eruptions and poleward oceanic heat transport.

According to climate models, the largest feedbacks are related to the Arctic's inefficiency at radiating heat. Cold regions radiate heat slowly, so the warmth trapped by greenhouse gases tends to build up. Furthermore, warming in the Arctic is concentrated close to the Earth's surface, slowing the rate at which heat is lost to space from the top of the atmosphere. The next-largest feedback comes from changes in surface reflectivity due to the melting of snow and ice, see ice-albedo feedback. Water vapor (a powerful greenhouse gas) also provides a warming feedback. Warmer temperatures increase evaporation, and a warmer atmosphere can hold more water vapor, thus ending in a never-ending negative circle.

Consequences

The clear trend is that sea-ice is melting earlier in the spring and freezing later in the autumn. Each summer the ice thins more and recedes further, leaving greater expanses of the ocean exposed to 24-hour sunlight.

Since 1979, the summer Arctic has lost 40% of its extent and up to 70% of its volume (see picture 1). Other scientists calculate the rate of decline at 10.000 tonnes a second. Much of the multiyear ice is now gone. Most of what is left is the younger, thinner layer from the previous winter, which is easier for the sun to melt and the wind to push around. Even if the carbon emissions are cut rapidly, the loss of summer sea-ice in the Arctic is now very likely before 2050 (research shows). However, cutting greenhouse gasses remains vital as this will determine whether Arctic summer ice vanishes permanently or if it could recover over time. If emissions remain very high, there is a risk the Arctic could be ice-free even in the winter months, this would be catastrophic for some wildlife species, such as the polar bear.



Picture 1 - Deterioration of Arctic Sea Ice Extent

The amount of atmospheric carbon dioxide absorbed by the Arctic Ocean may be significantly affected by changes in sea-ice cover, the structure and functioning of marine ecosystems, and the hydrological cycle thawing permafrost is expected to increase emissions of methane.

However, the Arctic will not return to previous conditions this century under the scenarios considered in the SWIPA (Snow, Water, Ice, Permafrost in the Arctic) 2017 assessment. The near-future Arctic will be a substantially different environment from that of today, and by the end of this century Arctic warming may exceed thresholds for the stability of sea ice, the Greenland ice sheet, and possibly boreal forests. Since 2011, evidence for the Arctic's evolution toward a new state has grown stronger. Additional years of data show continued or accelerating trends in record warm temperatures, changes in sea ice and snow, melting of glaciers and ice sheets, freshening and warming of the Arctic Ocean, thawing of permafrost, and widespread ecological changes.

Beyond the trends, new data also shows stronger evidence for fundamental shifts in some elements of the cryosphere, the ocean, and ecosystems. Sea ice in the Arctic is entering a new regime in which vast areas of ocean that used to be covered by ice throughout the year are now seasonally ice-free and dominated by younger, thinner ice. The composition of many boreal forests is changing: coniferous trees are increasingly being replaced by deciduous species normally found farther south. Together, these findings portray a system whose component parts are changing at different speeds, affecting the Arctic's role as a regulator of global temperature and its influence on Northern Hemisphere weather, its contribution to sea-level rise, the livelihoods of those who live and work in the Arctic, and the habitats of Arctic species. Today's Arctic is a new environment, evolving rapidly and in unexpected ways.

The SWIPA analysis estimates that when all sources of sea level rise are considered (not just those from the Arctic), the rise in global sea level by 2100 would be at least 52 cm for a greenhouse gas reduction scenario and 74 cm for a business-as usual scenario.

Coastal communities, low-lying islands, and ecosystems throughout the world will be affected by the melting of land ice (glaciers and ice sheets) in the Arctic, which is projected to increase the rate of global sea-level rise. Examples of impacts are coastal flooding, erosion, damage to buildings and infrastructure, changes in ecosystems, and contamination of drinking water sources. Impacts on (for example) shipping and fishing will lead to economic consequences in and outside the Arctic.

The rate and magnitude of changes projected for the Arctic will push some species out of their ranges, while other species may colonize new areas. For example, many species depend on sea-ice for survival and reproduction and their populations may decline with changes in sea-ice thickness and extent, while for example populations of non-native species may increase due to the warmer waters and reductions in sea-ice. More frequent wildfires and abrupt thawing of permafrost could accelerate ecological shifts, such as the spread of tall shrubs and trees into tundra.

The Arctic Council

The Arctic Council consists of the 8 Arctic States, who implement policy in the region: Canada, The Kingdom of Denmark, Finland, Iceland, Norway, The Russian Federation, Sweden and The United States. 6 permanent participants, representing the Indigenous peoples of the Arctic: Aleut International Association, Arctic Athabaskan Council, Gwich'in Council International, Inuit Circumpolar Council, Russian Association of Indigenous Peoples of the North, Saami Council. 6 working groups (see picture 2), who carry out the Council's activities: Arctic Contaminants Action

Picture 2 – Structure of the Arctic Council

Program, Arctic Monitoring and Assessment Programme, Conservation of Arctic Flora and Fauna, Emergency Prevention, Preparedness and Response, Protection of the Arctic Marine Environment, Sustainable Development Working Group. And 38 observers, who share their expertise; this group consists of Non-Arctic states (France, Germany, Italian Republic, Japan, The Netherlands, People's Republic of China, Poland, Republic of India, Republic of Korea, Republic of Singapore, Spain, Switzerland, United Kingdom), Intergovernmental and interparliamentary organizations (International Council for the Exploration of the Sea, International Federation of Red Cross & Red Crescent Societies, International Maritime Organization, International Union for the Conservation of Nature, Nordic Council of Ministers, Nordic Environment Finance Corporation, North Atlantic Marine Mammal Commission, OSPAR Commission, Standing Committee of the Parliamentarians of the Arctic Region, United Nations Development Programme, United Nations Environment Programme, World Meteorological Organization, West Nordic Council) and Non-governmental organizations (Advisory Committee on Protection of the Sea, Arctic Institute of North America, Association of World Reindeer Herders, Circumpolar Conservation Union, International Arctic Science Committee, International Arctic Social Sciences Association, International Union for Circumpolar Health, International Work Group for Indigenous Affairs, Northern Forum, Oceana, University of the Arctic, World Wide Fund for Nature, Arctic Programme).

The Arctic Council, works together on generating data and knowledge, monitoring the Arctic, assessing various aspects of the Arctic and making recommendations on how to preserve the Arctic.

AMAP (Arctic Monitoring and Assessment Programme)

AMAP is one of six Working Groups of the Arctic Council, who since its establishment in 1991, has produced a series of high quality reports and related communication products that detail the status of the Arctic with respect to climate and pollution issues and that includes policy-relevant science-based advice to the Arctic Council and governments. AMAP is mandated to: monitor and assess the status of the Arctic region with respect to pollution and climate change issues; document levels and trends, pathways and processes, and effects on ecosystems and humans, and propose actions to reduce associated threats for consideration by governments; produce sound science-based, policy-relevant assessments and public outreach products to inform policy and decision-making processes. AMAP's work is directed by the Ministers of the Arctic Council and their Senior Arctic Officials, who have requested AMAP to also support international processes that work to reduce the global threats from contaminants and climate change. These include the UN Framework Convention on Climate Change, UNEP's Stockholm Convention on Persistent Organic Pollutants and Minimata Convention on mercury, and the United Nation's Economic Commission for Europe (UN ECE) Convention on Long-range Transboundary Air Pollution.

Major Parties Involved

Greenpeace

Greenpeace is calling for the central Arctic to be declared a protected marine area. On World Oceans Day 2019, campaigners rallied outside parliaments in several countries to demand a new global treaty to end the overexploitation of the high seas. Greenpeace also campaigns against drilling in the Arctic.

Iceland

Member of the Arctic Council and part of the Arctic.Iceland is the current chair of the Arctic Council.

Denmark

Member of the Arctic Council and part of the Arctic.

Norway

Member of the Arctic Council and part of the Arctic.

Sweden

Member of the Arctic Council and part of the Arctic.

Finland

Member of the Arctic Council and part of the Arctic.

Russia

Member of the Arctic Council and part of the Arctic.

Canada

Member of the Arctic Council and part of the Arctic.

The United States of America

Member of the Arctic Council and part of the Arctic.

China

Countries like China have an interest in Arctic routes and resources. They are out to make profit off the deterioration of the Arctic.

Timeline of Key Events

1991	AMAP was established
19 September 1996	Ottawa Declaration was signed
1979	The United Nation's Economic Commission for Europe Convention on Long-range Transboundary Air Pollution was signed
22 May 2001	The Stockholm Convention on Persistent Organic Pollutant was signed
2003	Minimata Convention of Mercury was signed
2015	Paris Agreement was signed

UN involvement, Relevant Resolutions, Treaties and Events

- Declaration on the establishment of the Arctic Council, 19 September 1996
- Paris Agreement, 2015
- The Stockholm Convention on Persistent Organic Pollutants, 22 May 2001
- Minimata Convention of Mercury, 2003

- The United Nation's Economic Commission for Europe Convention on Long-range Transboundary Air Pollution, 1979

Previous Attempts to solve the Issue

The conventions and agreements mentioned in 'Timeline of Key Events' and 'UN involvement, Relevant Resolutions, Treaties and Events', have all had their uses. However a problem with the Paris Agreement is, that it does not have any legally binding powers and countries can step out of the agreement at any given time. Due to these factors the Paris Agreement did not reach its hoped impact. All previous attempts have helped a bit, however due to the global demand for fossil fuels these attempts were not successful in significantly lowering the greenhouse gas emissions to stop the global warming.

Possible Solutions

Substantial cuts in global greenhouse gas emissions are the basis of all possible solutions. If greenhouse gas emissions are cut now, this can stabilize impacts after mid-century, when greenhouse gas emissions continue to get higher, this will result in continued losses. Lowering the greenhouse gas emissions can be achieved through compliance with the Paris Agreement, which will have the following effects by the end of this century: stabilize temperature at 5–9°C above the 1986–2005 average over the Arctic Ocean in winter, reduce global sea-level rise from 2006–2100 by more than 20 centimetres, stabilize the duration of snow cover at about 10% below current values, stabilize near-surface permafrost extent at roughly 45% below current values. While the Paris Agreement, if implemented, would limit the extent to which the Arctic climate changes, the Arctic environment in 2100 would still be substantially different from that of today.

Reducing knowledge gaps will improve our ability to respond to current and future changes in the Arctic. Efforts are needed to increase the geographic coverage of observations, improve local-level projections, and reduce uncertainties. Through addressing these major knowledge gaps we will ensure that adaptation strategies are grounded in a solid understanding of potential impacts and interactions. As awareness of Arctic climate change and its consequences has grown, a number of international organizations, such as the

Intergovernmental Panel on Climate Change (IPCC), the World Meteorological Organization (WMO), and the International Council for Science (ICSU) through the International Arctic Science Committee (IASC), have become increasingly engaged in understanding the implications of Arctic change. Making advances in these areas will require international coordination; long-term commitments to funding; the application of traditional and local knowledge; engagement with stakeholders; and coordinated and enhanced observation networks.

Raise public awareness of the implications of changes in the Arctic cryosphere. Outreach and public sharing of information about Arctic climate change, its consequences, uncertainties, risks, adaptation options, and effects of emission reductions are key to informed governance and policy development. To create this public awareness, you could work together with international organizations such as IPCC and UNFCCC.

As Greenpeace has been trying to say for years, by preventing drilling we can protect the Arctic for the millions of people and animals that call it home and stop fossil fuel companies from making climate change worse. Greenpeace is also calling for the central Arctic to be declared a protected marine area.

Adaptation at the community and regional levels, both in the Arctic and globally, is essential. The near inevitability of accelerating impacts in the Arctic and globally between now and mid-century reinforces the urgent need for local and regional adaptation strategies that can reduce vulnerabilities and take advantage of opportunities to build resilience.

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Appendices

I. The Ottawa Declaration

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II. Paris Agreement

https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

III. The Stockholm Convention

http://www.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx

IV. The Minimata Convention on Mercury

http://www.mercuryconvention.org/Portals/11/documents/Booklets/COP3-version/Minamata-Convention-booklet-Sep2019-EN.pdf

V. SWIPA 2017 assessment

https://swipa.amap.no/